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## OCULOPLASTICS UPDATE

# Müller's Muscle Conjunctival Resection Ptosis Repair in the Aesthetic Patient

Kiran Sajja, MD <sup>a,b,\*</sup>, Allen M. Putterman, MD <sup>a</sup>

<sup>a</sup> Department of Ophthalmology and Visual Sciences, Illinois Eye and Ear Infirmary, University of Illinois at Chicago, Chicago, IL, USA

<sup>b</sup> Arena Eye Surgeons, Columbus, OH, USA

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**Abstract** Posterior eyelid ptosis repair via the Müller's muscle-conjunctival resection procedure is an effective, reliable, and simple technique for periorbital rejuvenation in the aesthetic patient. This procedure may be performed with other periorbital rejuvenation techniques without sacrificing results. Appropriate candidates are patients with maintained levator function whose ptotic upper eyelid elevates close to a normal eyelid level upon instillation of phenylephrine drops to the superior conjunctival fornix.

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\* Corresponding author at: Arena Eye Surgeons, 262 Neil Avenue, Suite 320, Columbus, OH 43215, USA. Tel.: +1 614 228 4500; fax: +1 614 221 0138.

E-mail address: [ksajja@arenaeyesurgeons.com](mailto:ksajja@arenaeyesurgeons.com) (K. Sajja).

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## 1. Introduction

Posterior eyelid ptosis repair via the Müller's muscle-conjunctival resection procedure with or without blepharoplasty is a valuable technique for periorbital rejuvenation in the aesthetic patient. The surgeon's ability to recognize eyelid ptosis and to ease in performing posterior eyelid surgical procedures is paramount in successfully integrating this technique into your surgical armamentarium.

Age-related or involutional ptosis is common and must not be overlooked in preoperative evaluation of an aesthetic patient. In our practice, patients often do not recognize the difference between upper eyelid ptosis and dermatochalasis. A detailed examination, including eyelid measurements and provocative testing, is important in determining the aesthetic and functional potential of eyelid ptosis repair with or without blepharoplasty.

Posterior eyelid surgical approaches may be daunting to the surgeon unfamiliar with surgical anatomy of the eyelid and orbit. In addition, the close proximity to the globe and the potential for vision-threatening complications are variables that only clinical experience will alleviate. Appropriate selection of surgical candidates with realistic goals is vital in developing the skills necessary to feel at ease with posterior eyelid surgical approaches.

The following sections will detail the preoperative evaluation/planning, surgical technique, postoperative management, and potential complications of posterior eyelid ptosis repair via the Müller's muscle-conjunctival resection procedure with or without blepharoplasty.

## 2. Preoperative evaluation

### 2.1. Degree of eyelid ptosis – see Fig. 1A

The margin–reflex distance 1 (MRD<sub>1</sub>) measurement is used to assess the upper eyelid position. The examiner holds a point light source at eye level directly in front of the patient and

the patient is asked to gaze at the light. The distance from the corneal light reflex to the central upper eyelid margin is the MRD<sub>1</sub>. The MRD<sub>1</sub> is measured in positive millimeters if the eyelid is above the corneal light reflex and measured in negative millimeters if the eyelid obscures the corneal light reflex. In unilateral cases of upper eyelid ptosis, the difference in MRD<sub>1</sub> of the normal side and the ptotic side indicates the amount of ptosis. The normal MRD<sub>1</sub> is approximately 3.5–4.5 mm; this value may be used to determine the amount of ptosis in bilateral cases. The MRD<sub>1</sub> is a more valuable clinical measurement compared to the vertical palpebral fissure as it is independent of the lower eyelid position.

### 2.2. Levator muscle function – see Fig. 1B and C

Levator function (LF) is used to assess the overall effectivity of the levator muscle/aponeurosis as an eyelid retractor. The levator muscle/aponeurosis is the principal eyelid retractor and decreased function may suggest dysgenesis of the levator muscle, abnormal innervation to the levator muscle, or traumatic disinsertion of the levator muscle/aponeurosis. The LF is measured as the excursion, in millimeters, of the upper eyelid from downgaze to upgaze with the frontalis muscle immobilized. The normal LF is approximately 15 mm. The frontalis muscle is an accessory eyelid retractor and if not immobilized will erroneously result in a higher LF measurement.

### 2.3. Phenylephrine test – see Fig. 2A and B

The Müller's muscle is a smooth muscle that is sympathetically innervated and involuntarily elevates the upper eyelid 2–3 mm (Beard, 1985). Its origin extends from the posterior aspect of the levator muscle and inserts at the superior tarsal margin (Müller et al., 1859; Dutton, 1994). The phenylephrine test uses an adrenergic agonist to stimulate the Müller's muscle and to elevate the upper eyelid. The phenylephrine test is performed in three steps (Putterman and Urist, 1975). First,

the MRD<sub>1</sub> is measured prior to instilling phenylephrine drops. Second, topical tetracaine drops are applied to the ocular surface and the patient's head is tilted backwards, the upper eyelid is elevated, and the patient is asked to gaze downwards. Several drops of 2.5–10% phenylephrine are instilled into the superior conjunctival fornix; this is repeated 2–3 additional times (Glatt et al., 1990). The patient is positioned in this manner to maximize effect on Müller's muscle and minimize ocular and systemic absorption. Finally, the MRD<sub>1</sub> is re-measured 3–5 min after instillation of the phenylephrine. The amount of upper eyelid elevation is used to determine the amount of Müller's muscle-conjunctival resection.

Prior to performing the phenylephrine test, the patient's clinical history should be thoroughly reviewed. Patients with a history of unstable or severe cardiac disease, hypertension, or angle-closure glaucoma should be excluded as systemic absorption of the phenylephrine may precipitate heart block, myocardial infarction, hypertensive crisis, or acute angle closure glaucoma (Glatt et al., 1990).

### 3. Anesthesia

The Müller's muscle-conjunctival resection ptosis procedure may be performed with minimal patient discomfort under local anesthesia consisting of 2% lidocaine with 1:100,000 U of epinephrine. In patients undergoing several concurrent periorbital rejuvenation procedures, oral/intravenous sedation or general anesthesia may be used without modifying the technique or decreasing the effectiveness or reliability of the postoperative result. This is not the case when performing an external levator advancement/resection ptosis repair procedures as patients should be conscious to optimize intraoperative adjustments (Ben Simon et al., 2005).

### 4. Surgical technique

Once the preoperative evaluation is complete, it is vital to recruit the appropriate patients for posterior approach ptosis repair using the Müller's muscle-conjunctival resection procedure. Historically, patients with mild ( $\leq 2$  mm) ptosis were considered appropriate, however, a recent study indicates that patients with moderate and moderate to severe ptosis may also be candidates. This suggests that patients with intact levator function ( $\geq 10$  mm) and a response to the phenylephrine test are suitable for the Müller's muscle-conjunctival resection procedure.

In the initial report of the surgical technique (Putterman and Urist, 1975), a response to the phenylephrine test in which the ptotic eyelid elevated to a normal level, 8.25 mm of Müller's muscle and conjunctiva is excised. A 6.25–9.75-mm graded resection of Müller's muscle and conjunctiva is performed if the ptotic eyelid elevates slightly higher or lower than the normal eyelid or ideal eyelid position, respectively (Putterman and Fett, 1986). Several studies have attempted to develop an algorithm to determine the appropriate amount of Müller's muscle-conjunctival resection, however, results have been variable and no method has been universally accepted (Mercandetti et al., 2001; Ben Simon et al., 2007; Ayala et al., 2007; Dresner, 1991; Perry et al., 2002). Clinical experience correlated with an individual surgeon's postoperative

results is the most predictive factor in obtaining serial reliable operative results.

#### 4.1. Step 1 – see Fig. 3A and B

A sterile marking pen is used to mark the upper eyelid skin prior to injection of local anesthetic. The eyelid crease incision may be marked along the patient's natural eyelid crease, however, in patients with upper eyelid ptosis the eyelid crease may be displaced superiorly or poorly defined. This is often the case in patients with aponeurotic or involutional eyelid ptosis, the most common cause of eyelid ptosis in adults. Therefore, the crease may be measured and marked according to the patient/surgeon preference in regard to gender, ethnicity, anticipated prominence of the upper eyelid skin fold, and brow position.

The height of the eyelid crease above the eyelid margin may be marked at three positions (the upper punctum, the mid-pupil, and the lateral canthal angle) and connected in a curvilinear manner extending 1–1.5 cm temporally in a slightly upward direction. In men, the marks are usually 8 mm nasally, 10 mm centrally, and 9 mm temporally. In women, the marks are usually 9 mm nasally, 11 mm centrally, and 10 mm temporally (Putterman and Fagien, 2008).

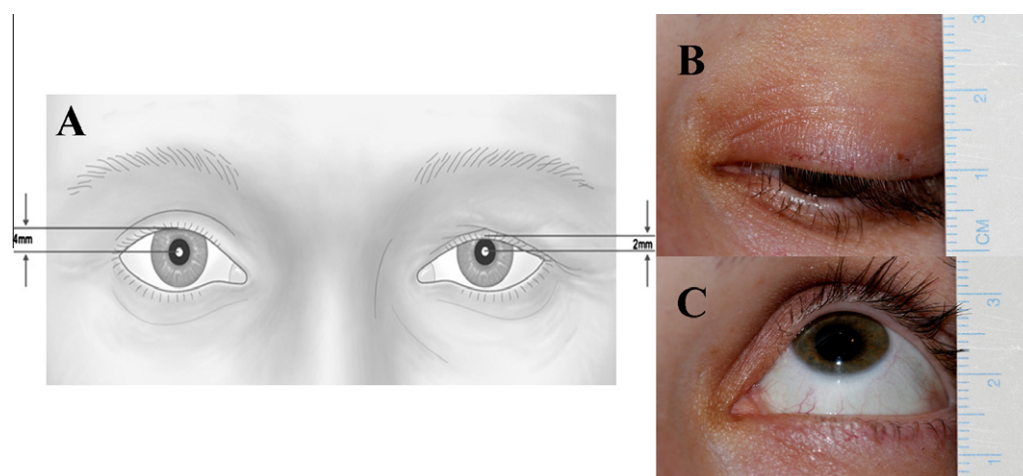
A skin “pinch” technique may be employed to determine the amount of upper eyelid skin to be excised. A smooth forceps is used to grasp the eyelid skin at the mid-pupil crease mark and several millimeters above, in order to “pinch” the redundant eyelid skin and slightly evert the eyelashes without elevating the eyelid, and marked. This is repeated at the upper punctum and lateral canthal angle marks. The markings are connected in a curvilinear fashion and joined at the nasal and temporal ends to the eyelid crease marking.

#### 4.2. Step 2 – see Fig. 3C

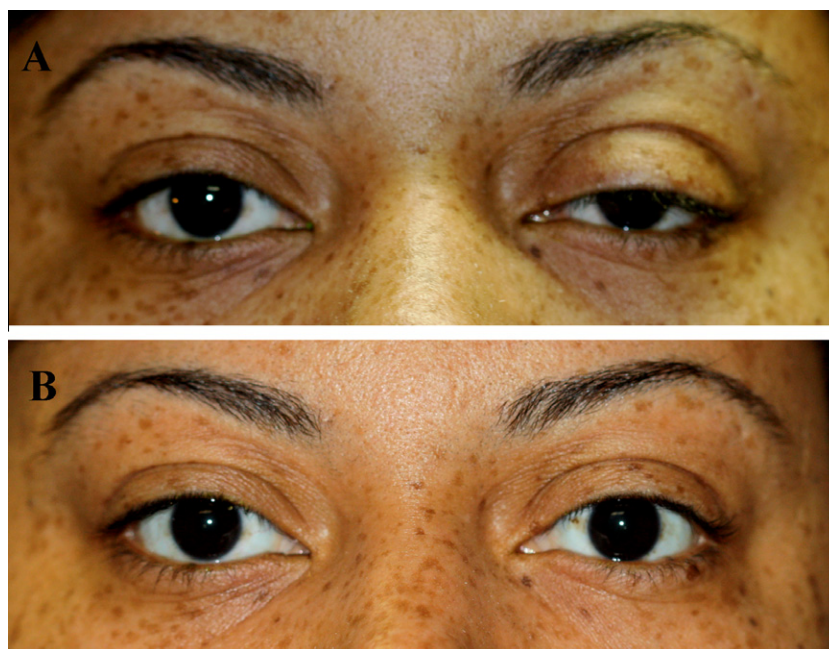
A small amount (0.5–1.0 mL) of local anesthetic is injected below the skin adjacent to the superficial skin markings. Overaggressive instillation of local anesthetic may cause inadvertent contraction of Müller's muscle in response to the epinephrine, as well as, making eyelid eversion more difficult. A surgical blade is used to make a superficial skin incision along the surgical markings.

#### 4.3. Step 3 – see Fig. 4

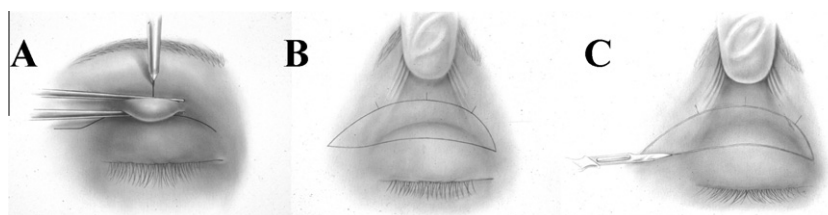
A 23-gauge retrobulbar needle is used to perform a frontal nerve block (Hildreth and Silver, 1976). This allows for sufficient anesthesia during the procedure without compromising normal eyelid architecture. One should palpate the supraorbital notch along the nasal aspect of the superior orbital rim to prevent inadvertent injury to the supraorbital neurovascular bundle. The retrobulbar needle is inserted into the superior orbit approximately 5–10 mm temporal to the supraorbital notch. The needle should hug the roof of the orbit during insertion and advanced to a depth of 4.0 cm; 1.5 mL of local anesthetic is injected. The needle should be withdrawn along the same path of insertion to avoid injury to the globe and orbital structures. Additional local anesthetic (0.25 mL) is injected subcutaneously over the center of the eyelid above the eyelid margin (see Fig. 5A).



**Figure 1** (A) Margin-reflex distance 1 (MRD<sub>1</sub>): The distance from the corneal light reflex to the central upper eyelid margin. The MRD<sub>1</sub> is +4 mm and +2 mm for the right and left upper eyelid, respectively. (B) Measuring the amount of levator function: marking the upper eyelid position in downgaze. (C) Marking the upper eyelid position in upgaze with the frontalis muscle immobilized; the excursion of the eyelid in downgaze to upgaze represents the levator function.

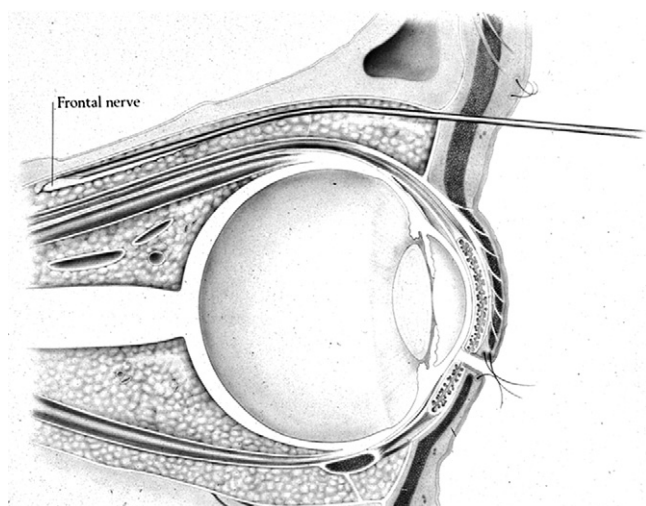


**Figure 2** A 37-year-old African-American woman presenting with left upper eyelid ptosis. (A) Prior to instillation of 2.5% phenylephrine drops. (B) Five minutes after instilling several drops of 2.5% phenylephrine onto the left superior fornix.



**Figure 3** (A) The upper eyelid crease is marked and the skin "pinch" technique is used to determine the amount of upper eyelid skin to be excised. (B) The upper eyelid markings designate an ellipse of tissue to be excised. Note that the markings are positioned superior to the lateral canthus, mid-pupil, and upper punctum. (C) After a small amount of local anesthetic is injected below the skin, a surgical blade is used to make a superficial skin incision along the skin markings.





**Figure 4** Frontal nerve block: A sagittal view of the orbit detailing the path of the retrobulbar needle along the roof of the orbit.



**Figure 5** Silk traction suture. (A) A small amount of local anesthetic is injected under the skin above the eyelashes at the central upper eyelid. (B) A 4-0 silk suture is passed through skin, orbicularis, and superficial tarsus approximately 2 mm above the eyelid margin.

#### 4.4. Step 4

A 4-0 silk traction suture is passed through skin, orbicularis muscle, and superficial tarsus 2 mm above the eyelid margin at the center of the eyelid (see Fig. 5B). The silk traction suture is pulled superiorly and the eyelid is everted over a Desmarres retractor to expose the palpebral conjunctiva from the superior

tarsal border to the conjunctival fornix. The size of the Desmarres retractor will depend on the laxity of the upper eyelid and the amount of conjunctiva–Müller's muscle to be excised; a medium and large-sized Desmarres retractor should be available. Several drops of topical tetracaine solution are irrigated over the globe and palpebral conjunctiva.

#### 4.5. Step 5 – see Fig. 6A

A caliper is set at the amount of conjunctiva–Müller's muscle to be excised. One arm of the caliper is placed at the superior tarsal border and the other arm facilitates accurate placement of a 6-0 silk marking suture. The marking suture is passed through conjunctiva centrally and approximately 7 mm nasally and temporally. It is important to engage only conjunctiva during placement of the marking suture as inadvertent passage through Müller's muscle may result in subconjunctival hemorrhage.

#### 4.6. Step 6 – see Fig. 6B

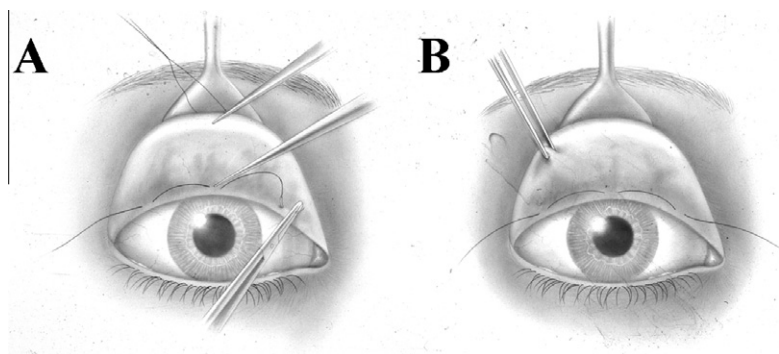
A toothed forceps is used to firmly grasp the conjunctiva and Müller's muscle between the superior tarsal border and the silk marking suture in order to separate Müller's muscle from the underlying levator aponeurosis. This maneuver is possible because Müller's muscle is firmly attached to conjunctiva and only loosely adherent to the levator aponeurosis. Mild inferior rotation of the Desmarres retractor will decrease tension on the eyelid allowing for greater separation of the structures during this maneuver.

#### 4.7. Step 7 – see Fig. 7A and B

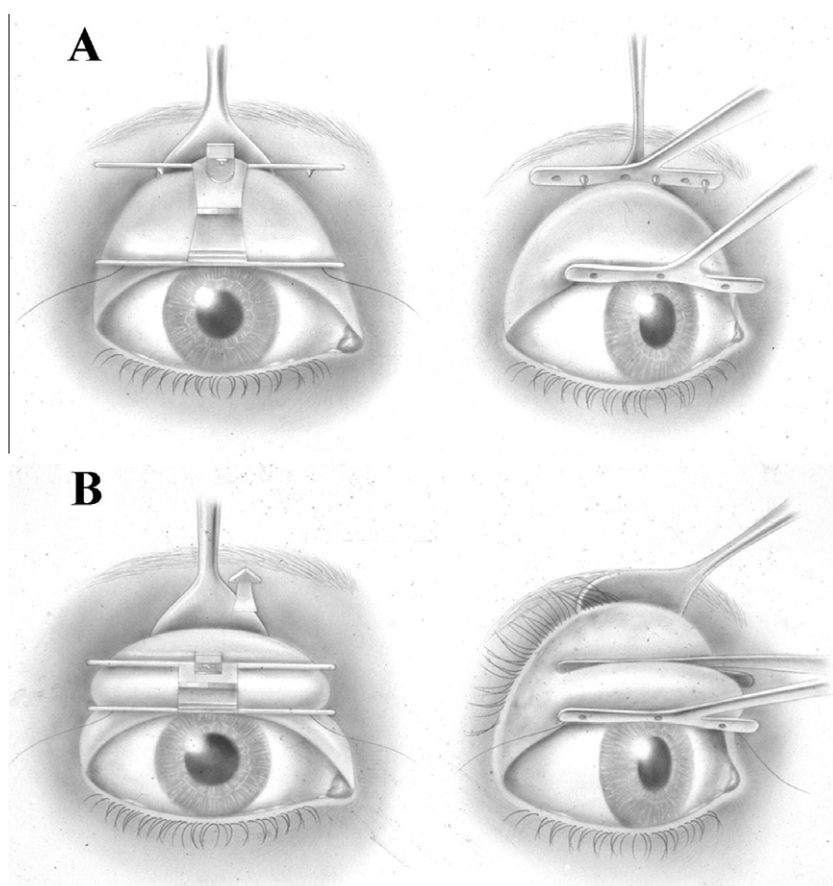
One blade of a specially designed clamp (Putterman Müller muscle–conjunctival resection clamp, Bausch & Lomb, Manchester, MO) is placed at the level of the silk marking suture. Each tooth of this blade engages the silk marking suture at its passage through the conjunctiva. The Desmarres retractor is slowly rotated from under the eyelid as the outer blade of the clamp engages the conjunctiva and Müller's muscle at the superior tarsal border. Any entrapped tarsus is pulled free from the clamp with the surgeon's thumb (see Fig. 8A). The clamp is firmly compressed and the handle locked in position incorporating the palpebral conjunctiva and Müller's muscle between the superior tarsal border and the silk marking suture. It is important that the placement of the clamp should reflect the relative position of the tarsal plate. In elderly patients or patients with significant upper eyelid laxity, the tarsus is attenuated and, often, temporally displaced; the clamp should be adjusted temporally to avoid eyelid contour abnormalities.

#### 4.8. Step 8 – see Fig. 8B

The upper eyelid skin is pulled superiorly while the clamp is pulled in the opposite direction. If significant tension or a sense of attachment is noted between the skin and clamp during this maneuver, then the levator aponeurosis is likely incarcerated within the clamp; the clamp should be released and reapplied as instructed in Step 7. This maneuver is possible because



**Figure 6** (A) Silk marking suture: The upper eyelid is everted over a Desmarres retractor and a caliper is used to measure the distance above the superior tarsal margin. A 6-0 silk suture is passed through conjunctiva centrally and 7 mm nasally and temporally. (B) A toothed forceps is used to firmly grasp the conjunctiva and Müller's muscle between the superior tarsal border and the silk marking suture in order to separate Müller's muscle from the underlying levator aponeurosis.



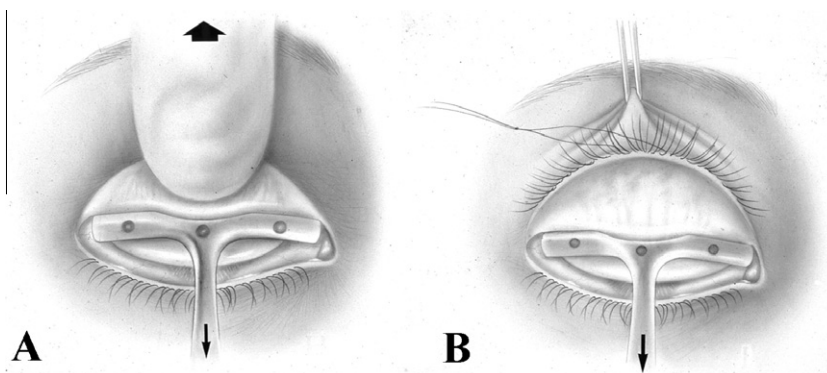
**Figure 7** Application of the Putterman Müller's muscle–conjunctival resection clamp. (A) One blade of the clamp is placed at the level of the silk marking suture. Each tooth of this blade engages the silk marking suture at its passage through the conjunctiva. (B) The Desmarres retractor is slowly rotated from under the eyelid as the outer blade of the clamp engages the conjunctiva and Müller's muscle at the superior tarsal border.

the levator aponeurosis sends extensions to the orbicularis muscle and skin to form the eyelid crease.

#### 4.9. Step 9 – see *Fig. 9A and B*

With the clamp held vertically, a double-armed 5-0 plain gut suture is run in a horizontal mattress fashion approximately

1.5 mm below the margin of the clamp along its entire width in a temporal to nasal fashion. The suture is passed through the conjunctiva and superior tarsal margin on one side of the clamp and conjunctiva and Müller's muscle on the opposite side of the clamp. In effect, the conjunctiva–Müller's muscle complex is advanced and reattached to the superior tarsal border. The suture passes are positioned adjacent to one another



**Figure 8** (A) Any entrapped tarsus is pulled free from the clamp with the surgeon's thumb. B: The upper eyelid skin is pulled superiorly while the clamp is pulled in the opposite direction. If significant tension or a sense of attachment is noted between the skin and clamp during this maneuver, then the levator aponeurosis is likely incarcerated within the clamp.

on the tarsal side and 2–3 mm apart on the opposite side of the clamp. This method decreases the corneal irritation and foreign body sensation experienced by the patient postoperatively.

*4.10. Step 10 – see Fig. 10*

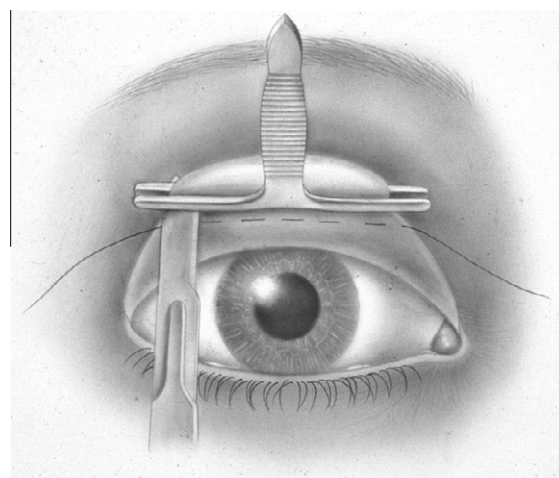
A #15 surgical blade is used to excise the tissue within the clamp by cutting between the suture and the clamp. The blade is beveled upward in direct contact with the clamp to prevent inadvertent lysis of the running suture. In addition, the surgeon must be careful not to cut the arms of the suture on either the nasal or the temporal end of the clamp.

*4.11. Step 11 – see Fig. 11A*

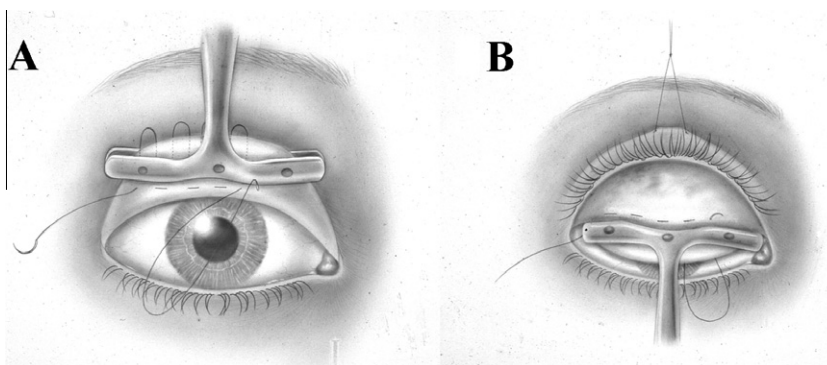
The Desmarres retractor is positioned to evert the eyelid while gentle traction is applied to the silk traction suture. The nasal arm of the plain gut suture is run in a continuous fashion in a temporal direction incorporating the superior tarsal border, Müller's muscle, and conjunctiva; each suture pass should be 2–3 mm apart. Great care must be taken to avoid cutting the original mattress suture with each pass; gentle suction and adequate hemostasis at the wound edges should be maintained. In addition, selection of a plain gut suture with a small, spatulated needle will help prevent inadvertent suture lysis.

*4.12. Step 12 – see Fig. 11B*

Once the nasal arm of the plain gut suture reaches the temporal aspect of the wound, each arm of the suture is passed

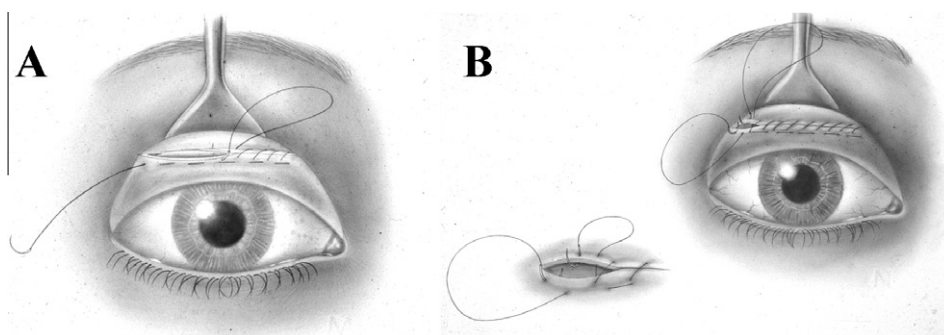


**Figure 10** Resection of Müller's muscle and conjunctiva: A #15 surgical blade is used to excise the tissue within the clamp by cutting between the suture and the clamp.

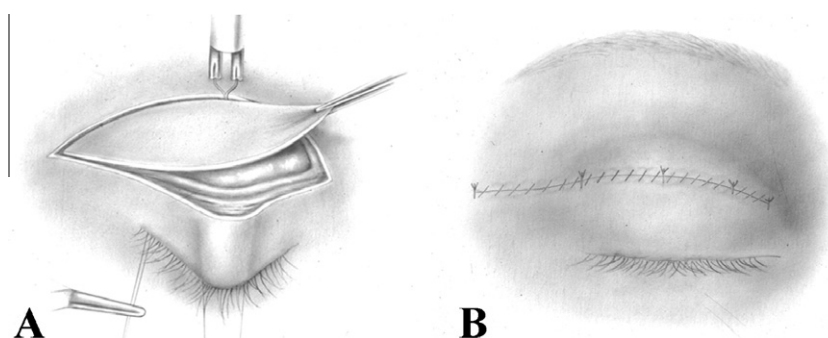


**Figure 9** Advancement of Müller's muscle and conjunctiva. (A) A double-armed 5-0 plain gut suture is run in a horizontal mattress fashion approximately 1.5 mm below the margin of the clamp along its entire width in a temporal to nasal fashion. View along the superior margin of resection adjacent to the superior conjunctival fornix. (B) View along the superior tarsal border.





**Figure 11** Closure of conjunctival wound. (A) The nasal arm of the plain gut suture is run in a continuous fashion in a temporal direction incorporating the superior tarsal border, Müller's muscle, and conjunctiva; each suture pass should be 2–3 mm apart. (B) Once the nasal arm of the plain gut suture reaches the temporal aspect of the wound, each arm of the suture is passed through conjunctiva and Müller's muscle into the wound.



**Figure 12** Completion of upper blepharoplasty. (A) The eyelid skin or skin/orbicularis muscle flap is excised using scissors or an electrocautery knife. (B) Several 6-0 interrupted sutures reinforce eyelid crease reconstruction. The wound is closed with a 6-0 running permanent suture.

through conjunctiva and Müller's muscle into the wound. The arms of the suture are pulled from the interior of the wound and tied with a surgeon's knot. The ends of the suture are cut adjacent to the knot allowing the knot to retract into the subconjunctival space. This helps to prevent postoperative keratopathy and foreign body sensation. If the patient is undergoing concurrent upper blepharoplasty, the arms of the suture can be pulled from the interior of the wound and placed aside without tying the suture. The Desmarres retractor can be removed and the eyelid can be placed in its normal anatomic position. Once the eyelid skin or skin and orbicularis muscle has been excised and hemostasis maintained, the knot may be tied as previously instructed. Performing the excision of skin or skin/muscle and hemostasis prior to tying the knot will prevent inadvertent suture lysis.

#### 4.13. Step 13 – see Fig. 12A and B

The eyelid skin or skin/orbicularis muscle flap is excised using scissors or an electrocautery unit. Careful and aggressive hemostasis is maintained using unipolar/bipolar cautery. The eyelid crease is reconstructed by passing 6-0 interrupted sutures through the levator aponeurosis and orbicularis at the three eyelid crease markings. Three 6-0 interrupted sutures through skin at the inferior wound edge, levator aponeurosis, and skin at the superior wound edge adjacent to the three eye-

lid crease markings reinforce eyelid crease reconstruction. The wound is closed with a 6-0 running permanent suture.

Orbital fat excision, lacrimal gland repositioning, and glabellar/brow procedures may be performed via the upper blepharoplasty incision.

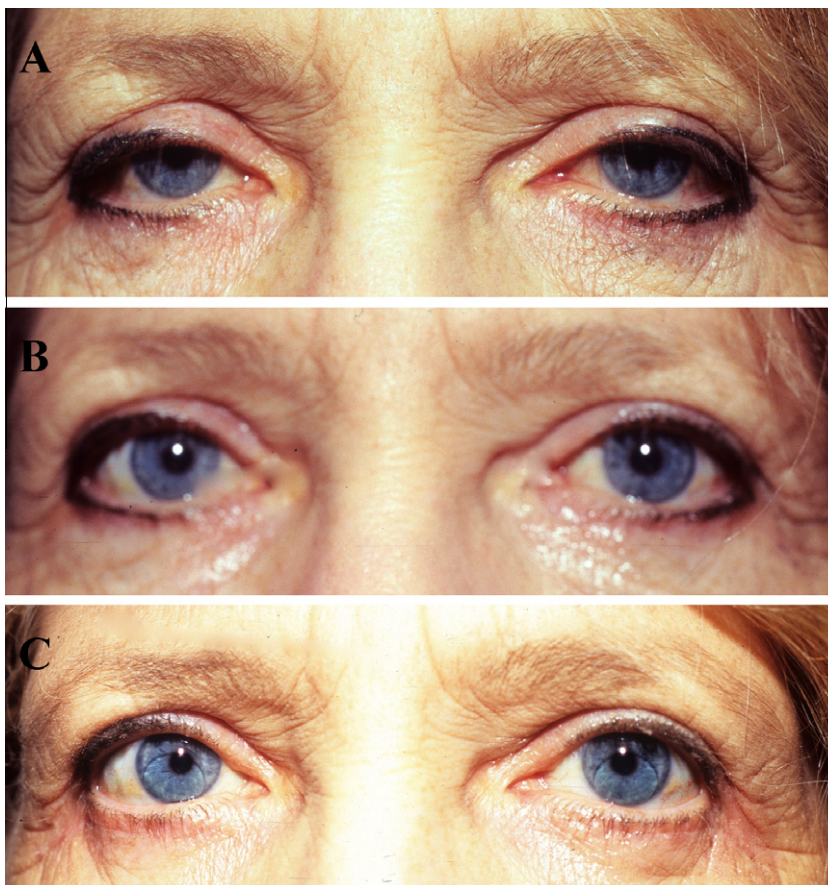
### 5. Postoperative management

A topical antibiotic ointment is generously applied over the surface of the eye at the completion of the procedure. The ointment should be applied 2–3 times daily for the first week and prior to bedtime for an additional week. A systemic antibiotic is not necessary following this procedure; however, if this procedure is combined with other periorbital rejuvenation procedures, prophylactic oral antibiotics may be added. Topical and/or systemic anti-inflammatory agents, such as steroids, are not necessary, but may be given as deemed appropriate.

Cold compresses are applied over the eyelids for the first 24 h to help prevent postoperative edema and may be used thereafter for patient comfort. It is important that patients recognize that there may be continued sensory anesthesia to the eyelid 4–6 h after the procedure and cycle the cold compresses to prevent superficial irritation.

Frequent use of ocular lubricants (drops and ointments) is important to prevent postoperative keratopathy and patient discomfort. Patients should be encouraged to use artificial





**Figure 13** A 56-year-old Caucasian woman presenting with bilateral upper eyelid ptosis. (A) Prior to instillation of 10% phenylephrine drops. (B) Five minutes after instilling several drops of 10% phenylephrine onto bilateral superior fornices. (C) Six weeks following bilateral Müller's muscle–conjunctival resection ptosis procedure combined with bilateral upper and lower blepharoplasty.

tears throughout the day for suture and exposure associated symptoms.

Patients should be instructed to experience worsening eyelid swelling and ocular discomfort for the first 48–72 h following the procedure. Vision is often blurred and distorted secondary to uneven tear film and frequent ocular lubricant administration. As the eyelid swelling and ocular discomfort improve, the patient may be instructed to use the artificial tears in lieu of the more viscous ocular lubricants. The eyelid usually attains its final level 3–6 weeks postoperatively (see Fig. 13).

## 6. Complications

The most common complication from posterior eyelid ptosis repair is corneal irritation and/or abrasion (Putterman and Fett, 1986). The combination of exposed suture material, postoperative eyelid edema, and relative increase in exposed ocular surface area may contribute to corneal epithelial derangement. Patients with postoperative lagophthalmos are at particular risk of developing corneal abnormalities and should be strongly encouraged to maintain an aggressive ocular lubrication regimen. A bandage contact lens or collagen shield may be used in symptomatic patients. Rarely, a corneal abrasion may develop into a corneal ulcer. These patients should be referred for urgent ophthalmologic evaluation to prevent vision threatening complications.

Over- or under-correction of eyelid position is observed in approximately 3–5% of cases (Putterman and Fagien, 2008). If a significant overcorrection occurs, downward massage of the eyelid while fixating the brow may be used in the early postoperative period. If the over-correction persists, a levator recession procedure can be performed (Putterman and Fagien, 2008). In cases of under-correction, a repeat posterior eyelid ptosis procedure may be performed, however, results are frequently unpredictable; more often a levator advancement or resection ptosis procedure is employed.

In rare cases, persistent hemorrhage from the Müller's muscle may occur. The Müller's muscle is a highly vascularized structure and patients on anticoagulation therapy, or restart anticoagulation shortly after the procedure, are at increased risk. Firm pressure over the eyelid for approximately 5 min will often cease the hemorrhage, however, persistent hemorrhage from the offending wound edge or vessel may require exploration and cauterization.

## 7. Conclusion

Posterior eyelid ptosis repair via the Müller's muscle–conjunctival resection procedure is an effective, reliable, and simple technique for periorbital rejuvenation in the aesthetic patient. Although posterior eyelid approach techniques may be daunting for the novice eyelid surgeon, with experience and patience,

one will be impressed with the ease and reproducibility of the procedure as translated to patient satisfaction.

### Conflict of interest

The authors report no conflicting financial interests.

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